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SIMBIOS Project 2003 Annual Report

Giulietta S. Fargion, Science Applications International Corporation, Maryland
Charles R. McClain, Goddard Space Flight Center, Greenbelt, Maryland

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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Chapter 6

Merging Ocean Color Data From Multiple Missions

Watson W. Gregg
NASA Goddard Space Flight Center, Greenbelt, Maryland

6.1 INTRODUCTION

Oceanic phytoplankton may play an important role in the cycling of carbon on the Earth, through the uptake of carbon dioxide in the process of photosynthesis. Although they are ubiquitous in the global oceans, their abundances and dynamics are difficult to estimate, primarily due to the vast spatial extent of the oceans and the short time scales over which their abundances can change. Consequently, the effects of oceanic phytoplankton on biogeochemical cycling, climate change, and fisheries are not well known.

In response to the potential importance of phytoplankton in the global carbon cycle and the lack of comprehensive data, NASA and the international community have established high priority satellite missions designed to acquire and produce high quality ocean color data (Table 6.1). Ten of the missions are routine global observational missions: the Ocean Color and Temperature Sensor (OCTS), the Polarization and Directionality of the Earth's Reflectances sensor (POLDER), Sea-viewing Wide Field-of-view Sensor (SeaWiFS), Moderate Resolution Imaging Spectrometer-AM (MODIS-AM), Medium Resolution Imaging Spectrometer (MERIS), Global Imager (GLI), MODIS-PM, Super-GLI (S-GLI), and the Visible/Infrared Imager and Radiometer Suite (VIIRS) on the NPOESS Preparatory Project (NPP) and the National Polar-orbiting Operational Environmental Satellite System (NPOESS). In addition, there are several other missions capable of providing ocean color data on smaller scales. Most of these missions contain the spectral band complement considered necessary to derive oceanic chlorophyll concentrations and other related parameters. Many contain additional bands that can provide important ancillary information about the optical and biological state of the oceans.

In previous efforts, we have established that better ocean coverage can be obtained in less time if the data from several missions are combined (Gregg et al., 1998; Gregg and Woodward, 1998). In addition to improved coverage, data can be taken from different local times of day if the missions are placed in different orbits, which they are. This can potentially lead to information on diel variability of phytoplankton abundances. Since phytoplankton populations can increase their biomasses by more than double in a single day under favorable circumstances (Eppley, 1972; Doney at el., 1995), observations of their abundances at different times within a single day would be useful.

We proposed to investigate, develop, and test algorithms for merging ocean color data from multiple missions. We seek general algorithms that are applicable to any retrieved Level-3 (derived geophysical products mapped to an Earth grid) ocean color data products, and that maximize the amount of information available in the combination of data from multiple missions. Most importantly, we will investigate merging methods that produce the most complete coverage in the smallest amount of time, nominally, global daily coverage. We will emphasize 3 primary methods: 1) averaging, 2) blending, and 3) statistical interpolation.

6.2. RESEARCH ACTIVITIES

We investigated a set of 3 merging algorithms utilizing Level-3 data products. None of the candidate algorithms were limited to any Level-3 grid size or temporal frequency. The choice of grid size and frequency issue depends on how sparse the final fields are and the acceptance level for data gaps. We leave this choice to the SIMBIOS Project. For our analyses, however, we used 25-km equiangular spatial, and daily time fields.

Candidate merger algorithms under investigation in this proposed effort were: averaging, blending, and statistical (optimal) interpolation.